An evaluation of the effectiveness of self-management interventions for people with type 2 diabetes after an acute coronary syndrome: a systematic review

Mu'ath Tanash,[1] Vivien Coates,[1] Donna Fitzsimons[1] and Christi Deaton2 (2016) "**An evaluation of the effectiveness of self-management interventions for people with type 2 diabetes after an acute coronary syndrome: a systematic review**", Accepted article by Journal of Clinical Nursing.

(1) University of Ulster, Institute of Nursing and Health Research , Belfast, UK
(2) University of Cambridge School of Clinical Medicine, Cambridge, UK

Running head:

REVIEW OF RCT INTERVENTIONS FOR PATIENTS WITH T2D AND ACS

Abstract:

Background: Type 2 diabetes is highly prevalent in patients with acute coronary syndrome and impacts negatively on health outcomes and self-management. Both conditions share similar risk factors. However, there is insufficient evidence on the effectiveness of combined interventions to promote self-management behaviour for people who with diabetes and cardiac problems. Identifying critical features of successful interventions will inform future integrated self-management programmes for patients with both conditions.

Objectives: To assess the evidence on the effectiveness of existing interventions to promote self-management behaviour for patients presenting with acute coronary syndrome and type 2 diabetes in secondary care settings and post discharge.

Design: We searched Medline, PubMed, CINAHL Plus, PsycInfo, Cochrane Library and AMED for randomised controlled trials published between January 2005 and December 2014. The search was performed using the following search terms of "acute coronary syndrome", "type 2 diabetes" and "self-management intervention" and their substitutes combined.

Results: Out of 4275 articles that were retrieved, only 4 trials met all the inclusion criteria (population, intervention, comparison and outcome) and were analysed. Overall, the results show that providing combined interventions for patients with both conditions including educational sessions supported by multimedia or telecommunication technologies were partially successful in promoting self-management behaviours. Implementation of these combined interventions during patient's hospitalisation and post discharge was feasible. Intervention group subjects, reported a significant improvement in self-efficacy, level of knowledge, glycated haemoglobin, blood pressure and fasting glucose test. However, there are many threats have been noticed around internal validity of included studies that could compromise the conclusions drawn.

Conclusion: With limited research in this area there was no final evidence to support effectiveness of combined interventions to promote self-management behaviour for patients with type 2 diabetes and acute coronary

syndrome. Sufficiently powered, good quality, well conducted and reported randomised controlled trials are required.

Keywords: type 2 diabetes; coronary heart disease; heart disease; self-care; self-management; caring intervention; intervention; randomised controlled trials

Summery Box

What does this paper contribute to the wider global clinical community?

- Clinicians need to be aware that the processes of validating the contents of combined interventions for patients with diabetes and cardiac problems are poorly described to date and there is a limited evidence base to work from, so integrated interventions need to be further developed and tested.
- Opens researchers' eyes to critical features and limitations of existing combined interventions designed for patients with T2D and ACS. And the importance of combining technology with high quality self-management interventions for patients with multiple chronic conditions that may contribute to effective health outcomes such as reduce a re-hospitalisation, mortality and morbidity rates.
- Further research is needed to develop robust combined self-management interventions including an evaluation of cost-effectiveness of implementing such interventions.

1. INTRODUCTION

Type 2 Diabetes (T2D) is a metabolic disorder, leading to hyperglycaemia and vascular complications such as stroke and myocardial infarction (MI) (WHO 2015). Where T2D and MI co-exist, these conditions generate high levels of mortality and morbidity worldwide; for example, 52% of fatalities of patients with T2D are related to cardiovascular disease (CVD) (Morrish *et al.* 2001). Recently, because of the relentless increase in incidence of diabetes worldwide (Yiling et al. 2013), it has been classed a global epidemic (Lorber 2014), affecting about 381.8 million (8.3%) adults; this number is expected to nearly double by 2035 (International Diabetes Federation 2013). However, despite patients' efforts to control their diabetes, data indicate that many will be faced with a CVD, mainly an acute coronary event (Kasteleyn *et al.* 2014). The strength of the pathophysiological link between both conditions means they share many associated risk factors contributing to increasing the risk of developing both conditions, such as hyperglycaemia, obesity, lack of physical activity, hypertension and high cholesterol (American Heart Association 2013).

The global registry of acute coronary events conducted a multinational prospective study of 16116 patients hospitalised with an acute coronary syndrome (ACS) (5403 with ST-elevation MI, 4725 non–ST-elevation MI and 5988 unstable angina). The study reported that 1 in 4 ACS patients suffered from diabetes (Franklin *et al.* 2004). In another recent national study conducted in Jordan and Saudi Arabia, the prevalence of diabetes in ACS patients was more than a half (Alnemer *et al.* 2012, Hammoudeh *et al.* 2013, Saleh *et al.* 2012). Undoubtedly, the combination of both conditions considerably decreases patients' quality of life (Uchmanowicz *et al.* 2013, Wermeling *et al.* 2012) and increases the risk of adverse outcomes (Franklin *et al.* 2004), symptom distress and self-management difficulties (Deaton *et al.* 2006), readmissions to the hospital for other cardiovascular events (Saleh *et al.* 2012), and increased risk of mortality at 30 days and one year post ACS event (Donahoe *et al.* 2007).

Several studies and guidelines emphasise the importance of improving discharge planning for all hospitalised patients with diabetes and cardiac problems beginning from the first day of admission through assessment of the patients' overall understanding of their conditions and checking their ability to perform self-management tasks immediately after discharge (American Diabetes Association 2012, Malaskovitz & Hodge 2014). Management of ACS and T2D are often complex and encompass several regimens that the patients have to implement to improve outcomes of their condition (Radhakrishnan 2012), and there is a potential for conflicts between these two treatment regimens that may compromise adherence (Cha *et al.* 2012). Self-management interventions are one of the key strategies contributing to the improvement of patients' outcomes, minimising their morbidity and mortality risks (Kasteleyn *et al.* 2014). However, such interventions, up to the present, have generally lacked integration and individualisation despite T2D and ACS sharing similar risk factors (Mayo Clinic 2014), so a combined intervention that meets the needs of this growing population would be logical and urgently needed.

To date, there is no particular definition of "self-management intervention". Based on current literature, Galdas *et al.* (2015) describe a self-management intervention as any intervention primarily tailored to develop cognitive and behavioural abilities and capabilities of patients to manage their conditions effectively through providing different types of support, training and education. However, tailoring such interventions requires assessment of the needs and abilities of the patients through initial evaluation of individual's characteristics and based on this evaluation the feedback should be more personalised. Evidence suggests that patients can be more motivated if they perceive that the intervention is relevant to their personalised condition and they believe that the intervention can enable them to achieve positive outcomes (Radhakrishnan 2012). Thus, the process of developing effective interventions could be expensive, taking both time and effort (Stellefson *et al.* 2008). Moreover, integrating the management of diabetes and cardiac problems is a complex and challenging process (Dunbar *et al.* 2015). This

calls for an urgent need to justify the evidence, cost and resources utilized in developing, implementing and evaluating combined interventions for managing individuals with long-term conditions.

In line with current developments in intervention development and information technology, health behaviour change interventions are increasingly research based (Noar *et al.* 2007). Healthcare professionals also believe that the health outcomes of patients with long-term conditions will improve if patients are motivated and feel involved in self-managing the complex treatment regimen (Noar *et al.* 2007, Riegel *et al.* 2009). Therefore, through this review of Randomised Controlled Trials (RCTs) "the gold standard", the authors' aim is to evaluate the evidence on the effectiveness of existing interventions to promote self-management behaviour for patients presenting with ACS following T2D in secondary care settings and shortly after discharge from hospital.

2. METHODS

2.1. Search methods

Comprehensive electronic searches were conducted on Medline (Ovid SP Version), PubMed, CINAHL Plus, PsycInfo, Cochrane Library and AMED and limited to the studies published in the English language and the period 2005-2014. The search was undertaken in February 2015. Three main keyword clusters were used related to T2D, ACS and self-management interventions. In order to discover relevant synonyms for the main keywords, a list of relevant terms for each cluster was created by reviewing the appendices of relevant reviews in the Cochrane Library and including Medical Subject Headings. Subsequently, 27, 35 and 21 synonyms were identified to explore self-management intervention, ACS and T2D respectively, and are presented in Table 1. Headings and subheadings for all keywords were exploded without focus a heading during the search. Abbreviations, truncation (*,$), wildcards (?,#), proximity searching (adj*n*, NEAR/*n*, W/*n*) and Boolean (and, or, not) were used as appropriate with each database to identify keywords with different spelling and terms. Final results of the search for keywords for population, intervention, comparison and outcomes (PICO) (Van Loveren & Aartman 2007) were combined together by using (and). Then the results of the search was limited to adults aged 18 years or over, humans and RCTs by using validated filters with each database such as for RCTs Cochrane Highly Sensitive Search Strategy to identify randomised trials in MEDLINE: (sensitivity and precision maximising version (2008 revision)) Ovid format was used for Medline database. Full copies of the printed searches are available from the main author. Identified duplicates were removed. Also, references lists of retrieved trials were manually reviewed to identify any other relevant studies.

Table 1: Alternative terms for key words

	Self-management intervention	Acute coronary syndrome	Type 2 diabetes
Alternative terms (Synonyms)	Self-care; Rehabilitation; Self-Monitoring ; Self Administration ; Activities of Daily Living; Health Education; Patient Education; Patient Participation; Patient compliance; patient adherence; health promotion; Behaviour therapy; Health behaviour; Program evaluation; Modification; Life style/ Interventions or changes; Psychosocial/treatment or therapy or intervention; Self-efficacy; Health care quality; Risk management; Manage risk; Risk care; Care risk; Reduction intervention; Risk prevention	ACS; Angina Pectoris; Heart attack; Heart disease; Cardiac disease; Vascular disease; Coronary disease; Coronary heart disease; CHD; Cardiovascular disease ;CVD; CV; Myocardial infarction; Acute myocardial infarction; Myocardial ischemia ; MI; AMI; Unstable coronary; Unstable angina; Acute angina; Microvascular angina; ST segment elevation myocardial infarction; STEMI; non-ST segment elevation myocardial infarction; NSTEMI; Coronary thrombosis; Acute coronary; Heart infarction; Arteriosclerosis / Atherosclerosis; Cardiac arrest; Macrovascular disease; Microangiopathy/ Microvascular disease/ Small vessel disease	Non insulin dependent diabetes mellitus; NIDDM; Type 2 diabetes mellitus; Type II diabetes mellitus ; T2DM; T2D; TIIDM; TIID; Insulin resistance; Hyperinsulinemia; Glucose intolerance; Diabetic; Glycaemic/Glycemic; Hyperglycemia/Hyperglycaemia/Hyperglycaemic/ Hyperglycemic; High blood glucose; Blood sugar; Uncontrolled glucose; Abnormal glucose level

2.2 Search outcome:

In total, the search yielded the identification of 6,032 studies. Of which, 808 studies were retrieved from Medline (Ovid SP Version), 2,887 PubMed, 832 CINAHL Plus, 176 PsycInfo, 1325 Cochrane Library and only 4 from AMED. A total of 1,757 duplicates were removed. Thus, the title and abstract of 4,275 studies were screened by the main author in accordance with the following inclusion and exclusion criteria that was developed a priori of the search according to PICO format (Van Loveren & Aartman 2007):

1. Population

Male or female, aged 18 or over from all ethnicities, socioeconomic and educational backgrounds, diagnosed with T2D (established or newly diagnosed), and recently experienced coronary event with at least one of the ACS classification. However, for example, studies that included both types of diabetes (1 and 2) participants, in which the results could not be extracted for participants with T2D only, were excluded.

2. Intervention

Interventions designed for patients with T2D following a coronary event, delivered by any healthcare professional/researcher and targeted to promote self-management and health outcomes for those patients

diagnosed with diabetes and ACS in secondary care settings and/or after discharge from hospital. Studies where the target intervention was a part of complex intervention, where its effects could not be isolated were excluded.

3. Comparison

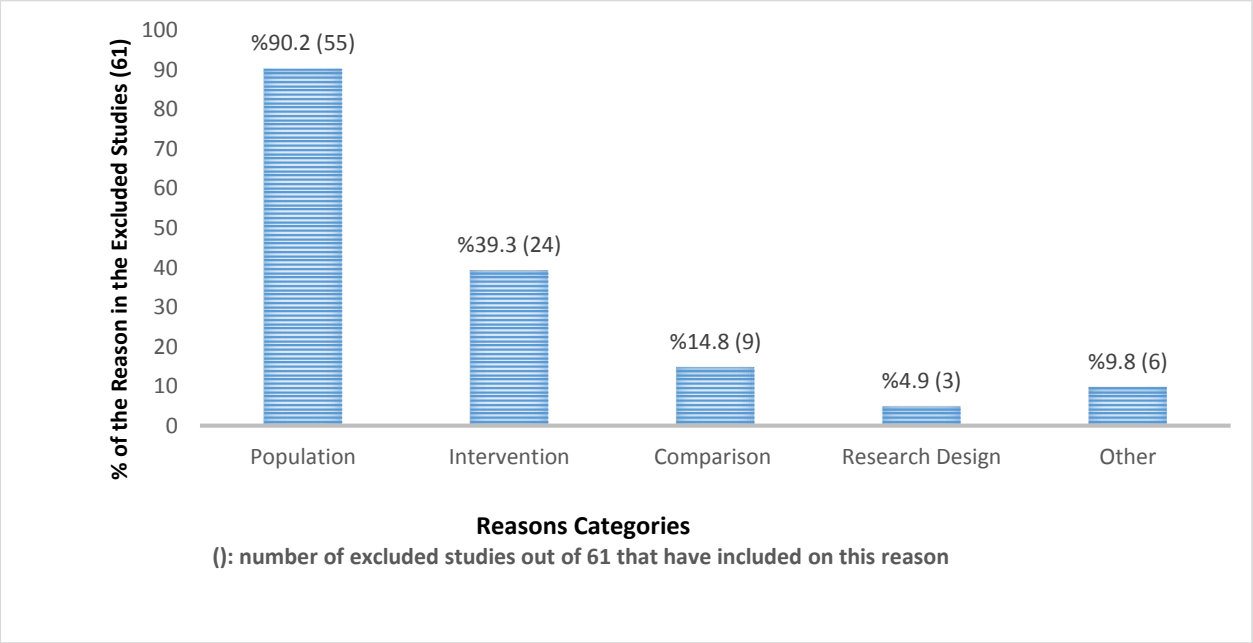
Usual care groups were compared against the groups that received usual care plus the intervention.

4. Outcomes

Any behavioural outcome such as self-care behaviour changes, dietary control, physical activity modification and adherence to medication; clinical outcomes such as HbA1c, blood pressure and cholesterol level; or psychological health outcomes such as self-efficacy, quality of life, knowledge and compliance level.

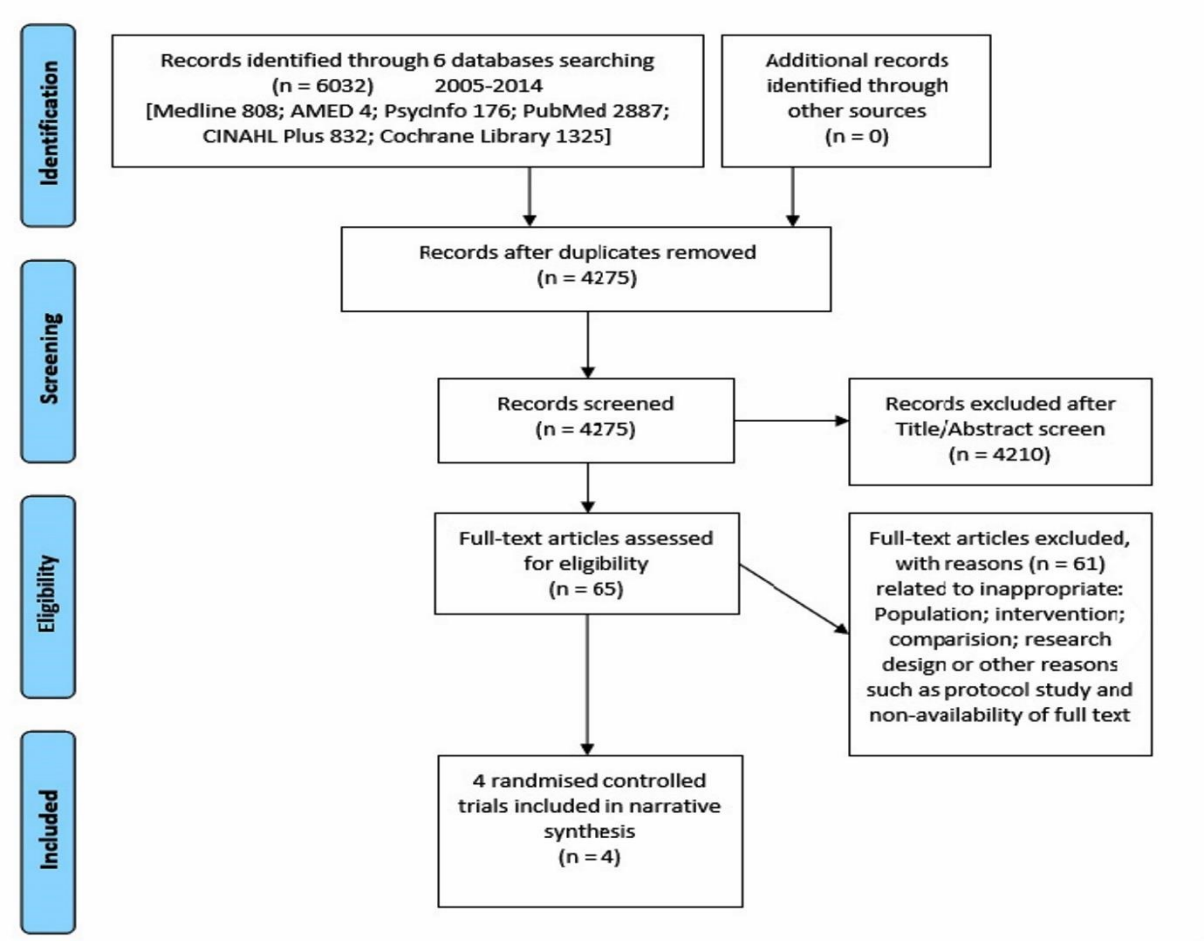
A total of 4,210 studies were excluded in accordance with our criteria. Full-text articles were obtained for the remaining 65 studies and examined in more depth by the main author. 61 studies were excluded and some of these studies were excluded included more than one reason. The reasons for exclusion were categorised into inappropriate in: Population (90.2%, did not include both conditions or did not focus on patients with diabetes post ACS); Intervention (39.3%, for example primary care interventions, not designed to be provided immediately after ACS or focused on evaluating the effects of a specific treatment such as a medication); Comparison (14.8%, no control group or the control group received an alternative treatment such as a specific procedure related to medication or diet); Research design (4.9% no evidence of randomization); and other (9.8% / 6 studies: 3 protocols, 1 conference abstract, 1 unavailable full-text and 1 duplicate). See Figure 1.

Figure 1: Reasons for Exclusion



The preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Guidelines was used to structure the review and the flow of information through the four phases of the systematic review is outlined in a Figure (2) as recommended by Moher *et al.* (2015).

Figure 2: PRISMA flow chart



2.3 Data extraction and quality assessment:

All titles, abstracts and full-texts identified were analysed according to our criteria by the main author. The reporting quality of each included study was assessed using the Consolidated Standards of Reporting Trials checklist (25-item checklist CONSORT) (Schulz *et al.* 2010). The reporting quality is shown in Table 2. The CONSORT checklists for the final included studies are available from the main author. The methodological quality was assessed independently by the main and second author using the Scottish Intercollegiate Guidelines Network (SIGN) 13-item methodology checklist for RCTs (Scottish Intercollegiate Guidelines Network 2012).

The items are especially designed to assess the internal validity by a series of statements. Based on responses, overall assessment for methodological quality was reported by using following coding system (++ for high quality study, + acceptable and 0 low quality). All differences in scoring were discussed between the two raters and the quality rating was reached through a consensus of opinion between the raters.

2.4 Data Synthesis:

The included studies varied in criteria in terms of eligibility, intervention characteristics and outcome results, therefore the extracted data could not be analysed quantitatively. Consequently, a decision was taken to provide a narrative synthesis as recommended by the PRISMA statement (Moher *et al.* 2015). The percentage of participants and drop-outs were calculated for each study. The summary results of the characteristics of population, intervention, outcome measures, randomisation procedure and key results were identified. A summary of the studies characteristics is shown in Table 3.

Table 2 - Reporting quality according to CONSORT

Description	Checklist item	N	%
Title and abstract	1a	2	50%
	1b	3	75%
Introduction			
Background and objectives	2a	4	100%
	2b	4	100%
Methods			
Trial design	3a	4	100%
	3b	0	0%
Participants	4a	3	75%
	4b	3	75%
Interventions	5	4	100%
Outcomes	6a	4	100%
	6b	0	0%
Sample size	7a	3	75%
	7b		N/A
Randomisation:Sequence generation	8a	3	75%
	8b	3	75%
Allocation: Concealment mechanism	9	2	50%
Implementation	10	1	25%
Blinding	11a		N/A
	11b		
Statistical methods	12a	4	100%
	12b	4	100%
Results			
Participant flow	13a	3	75%
	13b	2	50%
Recruitment	14a	3	75%
	14b		N/A
Baseline data	15A	2	50%
Numbers analysed	16	3	75%
Outcomes and estimation	17a	4	100%
	17b		N/A
Ancillary analyses	18		N/A
Harms	19	4	100%
Discussion			
Limitations	20	4	100%
Generalisability	21	1	25%
Interpretation	22	4	100%
Other information			
Registration	23	0	0%
Protocol	24	0	0%
Funding	25	3	75%

Study & Purpose	Population	Intervention	Outcome measures	Randomisation	Key results
1. Wu *et al.* 2012b Purpose Determine whether incorporation of patient peer supports in a cardiac-diabetes self-management program (CDSMP) lead to greater improvement in self-efficacy, knowledge and self-management behaviour	Inc. criteria ≥18 years; T2D; admitted to CCU with a critical cardiac event; had mobile phone and able to read and speak English. Exc. criteria Unable to read and speak English; or critically ill, unconscious or on respiratory ventilation. Main diagnosis ACS = 9 (32%) Heart failure = 10 (36%) Other Cardiac conditions = 9 (32%)	Includes 1st week: 3 face-to-face educational sessions +DVD in CCU 2nd week: 1 followed-up telephone call, and 2 text messaging reminders At 3rd &4th week: follow-up telephone. Providers: Main researcher+ trained peers Framework Self-efficacy theory Setting CCU + patient's home. Australia	1. Self-efficacy 2. Self-management behaviour 3. Self-management Knowledge Analysis: Descriptive, Using SPSS v18. -P<0.05	Allocation Table of random numbers. Concealment sealed, numbered, opaque envelopes Implementation NA Blinding No	Similarity - No significant difference between the 2 groups for material status, diagnoses, age, knowledge, self-efficacy and self-care behaviour levels at baseline outcomes. - Only a significant difference for gender (CG:12M / 1F and IG: 8M / 7F). Findings - Mann–Whitney U-tests indicated a significantly higher level of knowledge (Z=1.9, P=0.05) for the IG. - No significant difference (P>0.05) between the two groups for self-efficacy and self-care behaviour. Limitations - Small sample size - Intervener effects (trained research nurse). - Consistency between research staff and training of peers (lack of detailed training manual). - Insufficient number of training sessions for peer supporters thus, low in familiarity with the process of supporting patients. - Insensitivity of tools -Short follow-up period
2. Wu et al. 2012a Purpose Pilot test feasibility of the CDSMP incorporating telephone and text-messaging as follow-up approaches	Inc. criteria Patients with T2D and cardiac conditions who recovered from the initial critical cardiac event; physically stabilised; ready to received information and participate in discussion about their ongoing care Exc. criteria	Includes 1st week: 3 face-to-face educational sessions + educational booklet in CCU 2nd week: follow-up telephone call 3rd&4th week: follow-up text-messages Provider: The nurse researcher (highly trained RNs) Framework	1. Self-management behaviour 2. Self-efficacy 3. Quality of life indicators of fatigue and depression. 4. Diabetes Knowledge	Mechanism of both allocation, concealment and implementation are not reported Blinding No	Similarity - Overall, demographic and baseline data are not reported, the only data provided were about the mean score of self-efficacy for each group (around 125 of 200). Findings - Significant improvements for the experimental groups in self-efficacy (the mean about 175 of 200 for the IG and 140 for CG at T2). -No significant improvements for each of knowledge, self-care behaviour, fatigue and depressed levels. - Slight improvement without significance, in level of self-care behaviour.

	Not reported Main Diagnosis T2D and critical cardiac event	Self-efficacy theory Setting CCU Australia	Analysis Descriptive, Using SPSS v18. - P<0.05		- Feedback and comments of participants and their family indicated that follow-up telephone helped to resolve some of patients' concerns, and felt that they were supported by health professional. And the text-messaging reminders provide some usefulness toward continuing their daily self-management activities such as compliance with medication and diet. Limitations - Small simple size - Poor reporting - Insensitivity of tools -Short follow-up period
3. Wu et al. 2009 Purpose: develop and pilot test a Cardiac–Diabetes Self-Management Program (CDSMP) using an experimental design.	Inc. criteria Patients admitted to CCU with cardiac problem and have T2D; physically stabilised. Exc. criteria Not reported Main Diagnosis Not reported	Includes 1st week: 3 educational sessions in CCU 2nd week: 1 home visit 3rd&4th week: follow-up phone calls Provider: The main researcher Framework Self-efficacy theory Setting CCU + patents home. Australia	1. Mental health and vitality. 2. Diabetes Knowledge 3. Self-Efficacy 4. Feasibility of intervention. Analysis Descriptive, Using SPSS v18. - P<0.05	Allocation computer-generated table of random numbers Concealment NA Implementation NA Blinding No	Similarity No significances found in gender, material status and disease data between the 2 groups. Findings -Significant improvements in knowledge levels (from mean score 4 at T1 to 7 at T2) and no significant improvement in self-efficacy. - The feedback and comments of patients and staff indicated that the programme is feasible to implement in CCU with follow up at home. Because it provided viable information to promote patients self-management behaviours. And the staff showed their interest in this intervention to providing more appropriate care to the patients. Limitations - Small simple size - Insensitivity of tools -Short follow-up period
4. Soja et al. 2007 Purpose: Evaluate if an integrated approach of treatment would result in a better	Inc. criteria Had T2D and IGT; Patients admitted with ischemic heart disease, congestive heart failure, or high-risk cardiovascular patients with at least 3 classic risk factors.	Includes The first six weeks: patient education, supervised exercise training (90 minutes of training twice a week), nutritional counseling, supervised cooking lessons on location, smoking cessation, psychosocial support including a 24hr telephone line,	Clinical, biochemical and medication outcomes Analysis The SAS (version 8.2,	Allocation, concealment and Implementation all not reported Blinding No	Similarity The randomization was well balanced with no statistical difference at baseline between the 2 groups. Findings - Patients with T2D in the IG attained a significantly greater mean reduction in HbA1c, fasting plasma glucose, and blood pressure (diastolic & systolic) than those in the CG.

glycemic control and improve clinical outcome.	Exc. criteria Severe noncardiovascular disease, New York Heart Association stage IV, unstable patients awaiting revascularization, severe abuse of alcohol and sedatives, dementia patients Main Diagnosis: Ischemic heart disease (67%); Congestive heart failure (7%); At least 3 risk factors for ischemic heart disease (26%).	pharmacologic therapy, and risk factor management supported by a minimum of consultations by a physician after 3, 6, and 12 months; The program integrated with diabetes module (3 interactive teaching sessions of 2.5 hr each with in-depth information of self-care principles involving symptoms of peripheral arterial insufficiency, diabetic neuropathy, nephropathy, and retinopathy. Provider: Multi-professional health team Framework Several International guidelines Setting: University Hospital Denmark	SAS Institute, Cary, NC) statistical package - 2-sided P <0.05		- By the end of the study, patients with T2D in IG received a more intensified pharmacotherapy than those in the CG such as angiotensin converting enzyme inhibitor–angiotensin II receptor, antagonist (ACEI/ARA) and metformin. -Limitations: - It is not possible to evaluate which is the most important among the components in the combined risk factor management program. - There was a difference in pharmacotherapy treatment between the 2 study groups. - Focus on clinical and biomedical outcome only

Table 3: The summary of the characteristics of included studies

3. RESULTS

Four RCTs were identified. Two of them were pilot studies and a decision was taken to include them, as combined interventions to promote self-management behaviour for patients with T2D immediately after an acute cardiac event are underway and there is a need to consider each lesson that could be drawn from these studies even they were of a small scale or poorly reported. Understanding the key features of such studies may inform the direction in which to develop the structure and evaluate the feasibility of combined interventions to be used in future research. The results from a total of 146 patients are presented. The four trials included and their characteristics are shown in Table 4.

Table 4: Clinical Characteristics of identified studies

Name of Study	Time	Design	N	Comparison N (%)	Duration	Follow-up data	Drop-out % (n)/ reasons	Mean age ± year or range)	Men%	SIGN Rate
Wu *et al.* 2012b	Aug 2009 - Dec 2010	RCT-2arms	30	C:13 (46.4) I: 15 (53.6)	4 weeks	4 weeks	6.66 (2)/ transfer	I: 71.5 ± 9.9 C: 62.7 ± 13	71.4	+
Wu *et al.* 2012a	NR	RCT-2arms	20	C:10 (50) I: 10 (50)	4 weeks	4 weeks	NR	NR	NR	+
Wu *et al.* 2009	Dec 2005 - July 2006	RCT-2arms	28	C: 10 (50) I: 10 (50)	4 weeks	4 weeks	28.5 (8)/NR	NR	NR	+
Soja *et al.* 2007	March 2002 – March 2003	RCT-4arms [2arms for T2D patients & 2arms for IGT patients]	68 with T2D out of 104	C/T2D: 34 (50) I/T2D: 34 (50) C/IGT: 17 (47.2) I/IGT: 19 (52.8)	1 year	3 months and at 1 year	10.29 (7)/ NR	I:61.1 (43-79) C:65.7 (42-82)	65	++

Notes: C: control group; I: interventional group; NR: not reported; IGT: impaired glucose tolerance; N: number

Based on the SIGN checklist (Scottish Intercollegiate Guidelines Network 2012), the methodological quality of one of the identified trials was high quality (++) (Soja *et al.* 2007), and three were acceptable (+) (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b).

3.1 Countries and settings

Three of identified trials were conducted in Australia and one in Denmark. All the trials took place in an acute hospital setting with most patients recruited from the department of cardiology such as a Coronary Care Unit

(CCU) or cardiac rehabilitation setting. Patients in all included studies were invited to participate immediately after physiological recovery from cardiac problem.

3.2 Participants, diagnosis and study arms.

Two studies included patients who had T2D and had recovered from a coronary event without reporting any further classification about the diagnosis (Wu *et al.* 2009, Wu *et al.* 2012a). one included patients with T2D who had recovered from ACS (32%), other coronary conditions (32%) or heart failure (36%) (Wu *et al.* 2012b). Three studies incorporated a two arm trial design (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b), while one incorporated four arms and included patients who had either T2D (65.4%) or Impaired Glucose Tolerance (IGT) (34.6%) and had been admitted to hospital with either ischemic heart disease (67%), congestive heart failure (7%), or had at least 3 risk factors for ischemic heart diseases (26%) (Soja *et al.* 2007).

3.3 Baseline data and similarity

Sample sizes ranged from 20–68 participants. The main purpose of randomisation in RCTs is to achieve interventional groups with similar baseline characteristics. To promote internal validity, assessing the significance of differences between the two groups at baseline is essential (Sedgwick 2014). Significant differences between two groups at baseline were reported in three studies. Two of them reported no substantial difference (Soja *et al.* 2007, Wu *et al.* 2009), and one found a significant difference in gender, where the control group included only one female out of 13 participants, and this perhaps has affected the study outcome (Wu *et al.* 2012b). However, inadequate information about the differences in characteristics between groups at baseline were observed in these three studies, where some related and influential factors such as educational level, social classification and employment status were not taken into account. Moreover, one study did not mention any demographic data or describe the differences between the two groups at baseline (Wu *et al.* 2012a). Failure to use appropriate groups and assess the important differences in the composition of the study groups at baseline with regard to characteristics that could affect response to the intervention being investigated, could lead to a bias in outcomes (Scottish Intercollegiate Guidelines Network 2012).

3.4 Drop-out, duration of intervention and follow-up time

Dropout rates ranged from 6% to 28% with an average of 15.15% in three studies, one study reported loss to follow-up (Wu *et al.* 2012b). The duration of the intervention was 4 weeks and the follow-up data were collected

immediately after the intervention was completed in three studies (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b). While in one study the duration was 12 months and the follow-up data were collected at 3 and 12 months. (See table 3) (Soja *et al.* 2007).

3.5 Intervention characteristics

The intervention of two trials was a Cardiac-Diabetes Self-Management Programme (CDSMP) whose design was based on self-efficacy theory (Bandura 2004), to provide educational information aimed at developing basic skills of self-management such as monitoring blood glucose level. This programme was combined with a booklet of educational concepts and fictitious patients' stories to encourage patients to think positively and apply the self-efficacy model strategies (Wu *et al.* 2009, Wu *et al.* 2012a). The same programme was used in the Wu *et al.* (2012b) study after being modified by adding a Digital Video Disc (DVD) depicting models of successful self-management and using trained peers to follow-up patients after discharge. On the other hand, the Soja *et al.* (2007) study provided a secondary prevention programme constructed according to international guidelines such as rehabilitation of people with heart disease using Danish clinical guidelines (Danish Heart Foundation and Danish Society of Cardiology 1997) and standards of medical care for patients with diabetes mellitus (American Diabetes Association 2001). The study used an intensified comprehensive cardiac rehabilitation programme and combined educational sessions, supervised exercise training and cooking lessons, smoking cessation, nutritional counselling, psychosocial support, physician consultations and pharmacologic therapy. Also this programme was integrated with a diabetes module that comprised individual counselling and interactive teaching sessions.

All interventions combined at least two types of medium to deliver the components of the intervention, but were commonly delivered through in person one-to-one sessions at healthcare setting such as a CCU, a physician/outpatient clinic or the patients' home, then followed with telephone calls or text messages to deliver counselling and consultations. One study used a multimedia DVD to deliver a part of the intervention (Wu *et al.* 2012b). Another comprised of interactive teaching sessions (Soja *et al.* 2007).

A range of providers delivered the included interventions such as by only a researcher (Wu *et al.* 2009), the nurse researcher who was a highly trained registered nurse and had coronary and diabetes care experience (Wu *et al.* 2012a), or engaged with trained peers who were former patients with similar diseases and followed-up patients by telephone calls and text messages (Wu *et al.* 2012b). In Soja *et al's.* (2007) study the providers were a multi-professional team including nurses, physicians trained in cardiology and internal medicine and they were

supported by specialists such as a podiatrist and ophthalmologist to provide regular surveillance for patients with T2D.

3.6 Outcome measures

A wide variety of outcome measures were used, but no study assessed a combination of clinical, behavioural and psychosocial variables. Instruments such as questionnaires and scales were used in three studies to measure self-management outcomes (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b). One study measured the significant changes in the clinical and biomedical variables to assess the effectiveness of the intervention (Soja *et al.* 2007). Data were analysed descriptively by using SPSSv18 (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b), or SASv8.2 (Statistical Analysis System) (Soja *et al.* 2007). In all studies statistical significance was defined as 1 or 2-sided $P<0.05$ (see table 3).

3.6.1 Psychological outcomes

Psychological outcomes were measured at baseline and 4 weeks follow-up by the diabetes management self-efficacy scale (McDowell *et al.* 2005) and diabetes knowledge questions (Persell *et al.* 2004) in three studies (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b). One study (Wu *et al.* 2012a) used selected items from the subscales of Brief Profile of Mood States (POMS) (Cella *et al.* 1987) to assess depression and fatigue. One study (Wu *et al.* 2009) used mental health and vitality subscales of SF-36 version 2 (Ware *et al.* 2001).

Two studies reported significant improvements for experimental groups in self-management knowledge (Wu *et al.* 2009, Wu *et al.* 2012b) and only one study found a positive effect on self-efficacy of diabetes management (Wu *et al.* 2012a). Other variables such as depression, fatigue, mental health and vitality levels did not reveal any improvements for the experimental group.

3.6.2 Behavioural outcomes

The only behavioural outcome measured was self-management behaviour. Two studies (Wu *et al.* 2012a, Wu *et al.* 2012b) measured the self-management behaviour at baseline and 4 weeks follow-up by a Summary of Diabetes Self-care Activities (Toobert *et al.* 2000). This is a reliable and valid self-report questionnaire that includes items assessing the following aspects of the diabetes self-management regimen: specific diet, general diet, blood-glucose testing, exercise, smoking and foot care. However, the self-management behaviour did not record any improvement in either study, but that may be due to insensitivity of the instrument especially with the short follow-

up period (at 4 weeks) in both studies. It is worth noting that no studies included a specific instrument to measure heart disease self-management.

3.6.3 Clinical outcomes

In only one study were clinical and biomedical outcomes measured at baseline, 3 and 12 months follow-up (Soja *et al.* 2007). The glycated haemoglobin A1c (HbA1c) was measured as a primary outcome to assess if an integrated intervention would result in better glycaemic control. The differences in the mean of systolic and diastolic blood pressure, lipid control, exercise capacity and other lifestyle modifications were measured as secondary outcomes. However, after one year of use of an intensified comprehensive cardiac rehabilitation program, patients with T2D in the experimental group reported a significant improvement in the mean of HbA1c, fasting plasma glucose level, systolic and diastolic blood pressure.

3.6.4 Other outcomes

The feasibility of the combined intervention or part of it was assessed in two studies (Wu *et al.* 2009, Wu *et al.* 2012a). In one study, the feedback from experimental patients and CCU staff on implementing the intervention revealed that it was feasible to hold the educational sessions in a CCU with follow-up at the patient's home and the provided information helped patients to improve their self-management of both conditions (Wu *et al.* 2009). In another one, the experimental patients and their family were encouraged to provide feedback and comments at the end of the program to assess feasibility and acceptability of incorporating the telephone calls and text-messaging as follow-up approaches. The findings indicated that using follow-up telephone support helped to resolve some patients' concerns after discharge and left a positive impression about support of health professionals for them. Regarding using reminders and reinforcing text messages to the participants and their families, data suggest some usefulness for their ongoing daily self-management, although the participants expressed a desire to receive less written information (Wu *et al.* 2012a).

4. DISCUSSION

A key finding of this systematic review is that there were so few studies that were suitable for inclusion, as this highlights the dearth of evidence on this important clinical issue. Recently, Dunbar *et al.* (2015) concluded that providing an integrated self-care intervention for patients with heart failure and diabetes can significantly improve patients' quality of life, physical functioning and self-reported physical activity. The findings of this review

indicated that providing a combined intervention for patients with T2D and a cardiac problem in secondary care settings and immediately after discharge from hospital is feasible and suggests these were marginally successful in promoting self-management behaviour. Although none of included studies performed an analysis for both the clinical and psycho-behavioural outcomes together for diabetes and cardiac problems, suggesting that there is a lack of standardization for measuring outcomes of both conditions. However, there did not seem to be an association between medium, duration, providers or dose of combined interventions and intended outcomes in the included studies.

Innovative approaches such as combining the interventions with multimedia technologies or using DVD, follow-up telephones and text-massaging showed effectiveness and applicability to some extent in the included studies. Study participants and their families indicated positive feedback and quite useful experiences. However future research could focus on evaluating efficacy of using multimedia technology only as a way of testing the efficacy of separate components with the programme, and also on investigating the efficacy of using the interactive telecommunications technologies like an interactive text messaging model in conjunction with interventions designed to improve self-management for patients with both long-term conditions.

None of the four studies addressed the cost and resources used in developing and implementing the interventions. Therefore, future research should focus on assessing cost-effectiveness of combining these interventions and provide formal cost-benefits analysis for developing and implementing it. Power analyses to determine effect size were not reported. Moreover, all included studies had inadequate sample size and three of them recommended the need for a larger sample to determine the real effectiveness of its interventions (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b). Therefore, no final conclusion about the effectiveness of these interventions could be reached until a larger, sufficiently powered study is undertaken (Portney & Watkins 2009).

The results of the review should be considered carefully because some threats to the internal validity were observed within included studies. In addition to poor reporting of integration process and inadequately powered samples in above interventions, there were some issues related to inadequate assessment of validity and reliability for some intervention materials such as DVDs and educational booklets (Wu *et al*. 2009, Wu *et al*. 2012a, Wu *et al*. 2012b), and problems with fidelity in delivering the combined interventions as a result of variability among providers where some combined interventions or part of them were provided by different professionals or peer supporters with lack of a clear protocol or inappropriate training plan for them. Furthermore, there were a range of types of bias (selection, performance and detection) associated with the methods of the included RCTs due to

lack of blinding, poor allocation and concealment mechanisms; inadequate assessment of the differences between baseline characteristics of the groups that were compared; and systematic differences between groups such as significant differences in using intensified pharmacotherapy between study groups (Soja *et al.* 2007) and weak consistency among intervention providers and among peer supporters (Wu *et al.* 2012b). Further research should take into consideration these limitations to strengthen the internal validity of a combined intervention design, thus enhancing the reliability of the subsequent results.

5. RELEVANCE TO CLINICAL PRACTICE

At the conclusion of this systematic review, several lessons and challenges have been identified from existing combined interventions designed to promote self-management behaviour and health outcome for patients with T2D and ACS that needs to be considered in future research. With limited research in the area of developing integrated self-management interventions for patients with multiple chronic conditions in general and testing these interventions by RCTs, recognised as the gold standard evaluation design before translation to practice, there was no final evidence to support effectiveness of combined interventions to promote self-management behaviour for patients with T2D and ACS. Despite the increasing prevalence of people living with more than one chronic condition we continue to treat and manage each one separately. There is a dearth of evidence to support people who are living with both these conditions. There is an urgent need to develop robust programmes that address this area of clinical practice.

FUNDING

None

CONTRIBUTIONS

Contributed to conception, design, data extraction and analysis and drafted this article: MT, DF, VC. Contributed to search databases, article acquisition and screening for inclusion, and critically revised this article: MT. Contributed to manuscript preparation and revised this article: CD; All authors have approved this version and agree to be published.

References

Danish Heart Foundation and Danish Society of Cardiology (1997) Danish Heart Foundation and Danish Society of Cardiology Rehabilitation of people with heart disease - Danish clinical guidelines, Copenhagen.

Alnemer KA, Alfaleh HF, Alhabib KF, Ullah A, Hersi A, Alsaif S, Taraben A, Hussein G & Butt M (2012) Impact of diabetes on hospital adverse cardiovascular outcomes in acute coronary syndrome patients: Data from the Saudi project of acute coronary events. *Journal of the Saudi Heart Association* **24**, 225-231.

American Diabetes Association (2001) Standards of medical care for patients with diabetes mellitus. *In Diabetes care*, pp. S33-43.

American Diabetes Association (2012) Introduction: The American Diabetes Association's (ADA) evidence-based practice guidelines, standards, and related recommendations and documents for diabetes care. *Diabetes care* 35 Suppl 1, S1-S2.

American Heart Association (2013) Cardiovascular Disease & Diabetes. American Heart Association Available at: http://www.heart.org/HEARTORG/Conditions/Diabetes/WhyDiabetesMatters/Cardiovascular-Disease-Diabetes_UCM_313865_Article.jsp/ (accessed 21/09/2015).

Bandura A (2004) Invited essay: Swimming against the mainstream: the early years from chilly tributary to transformative mainstream. *Behaviour Research and Therapy* **42**, 613-630.

Cella DF, Jacobsen PB, Orav EJ, Holland JC, Silberfarb PM & Rafla S (1987) A brief poms measure of distress for cancer patients. *Journal of Chronic Diseases* **40**, 939-942.

Cha ES, Clark PC, Reilly CM, Higgins M, Lobb M, Smith AL & Dunbar SB (2012) Educational Needs for Improving Self-care in Heart Failure Patients with Diabetes. *The Diabetes educator* **38**, 673-684.

Deaton C, Kimble LP, Veledar E, Hartigan P, Boden WE, O'Rourke RA & Weintraub WS (2006) The synergistic effect of heart disease and diabetes on self-management, symptoms, and health status. *Heart & Lung: The Journal Of Critical Care* **35**, 315-323.

Donahoe SM, Stewart GC, McCabe CH, Mohanavelu S, Murphy SA, Cannon CP & Antman EM (2007)Diabetes and mortality following acute coronary syndromes. *JAMA* **298**, 765-775.

Dunbar SB, Reilly CM, Gary R, Higgins MK, Culler S, Butts B & Butler J (2015) Randomized Clinical Trial of an Integrated Self-Care Intervention for Persons With Heart Failure and Diabetes: Quality of Life and Physical Functioning Outcomes. *Journal of cardiac failure* **21**, 719-729.

International Diabetes Federation (2013) IDF Diabetes Atlas. (6th ed), Avalible at International Diabetes Federation website: https://www.idf.org/sites/default/files/EN_6E_Atlas_Full_0.pdf (accessed 10 April 2016)

Franklin K, Goldberg RJ, Spencer F, Klein W, Budaj A, Brieger D, Marre M, Steg PG, Gowda N & Gore JM (2004) Implications of diabetes in patients with acute coronary syndromes. The Global Registry of Acute Coronary Events. *Arch Intern Med* **164**, 1457-1463.

Galdas P, Fell J, Gilbody S, Bower P, Kidd L, McPherson K, Blickem C, Hunt K & Richardson G (2015) The effectiveness of self-management support interventions for men with long-term conditions: A systematic review and meta-analysis. *BMJ Open* **5**.

Hammoudeh S, Bener A, Zirie M, Al-Hamaq A, Chandra P, Moses O, Dos Santos H & Tonstad S (2013) The effect of non-exercise activity thermogenesis on subjects with metabolic syndrome - A proof of concept study in Qatar, *Qater Medical Journal* **1,** pp.12-18

Kasteleyn MJ, Gorter KJ, Stellato RK, Rijken M, Nijpels G & Rutten GEHM (2014) Tailored support for type 2 diabetes patients with an acute coronary event after discharge from hospital - Design and development of a randomised controlled trial. *Diabetology & Metabolic Syndrome, Open:***6**:5 (1).

Lorber D (2014) Importance of cardiovascular disease risk management in patients with type 2 diabetes mellitus. *Diabetes, Metabolic Syndrome And Obesity: Targets And Therapy* **7**, 169-183.

Malaskovitz J & Hodge C (2014) Addressing Glycemic Targets from Diagnosis to Discharge. *Diabetes Spectrum* **27**, 169-173.

McDowell J, Courtney M, Edwards H & Shortridge-Baggett L (2005) Validation of the Australian/English version of the Diabetes Management Self-Efficacy Scale. *International journal of nursing practice* **11**, 177-184.

Moher D, Shamseer L, Clarke M, Ghersi D, Petticrew M, Shekelle P, Stewart LA, Altman DG, Booth A, Chan AW, Chang S, Clifford T, Dickersin K, Gøtzsche PC, Grimshaw JM, Groves T, Helfand M, Higgins J, Lasserson T, Lau J, Trikalinos TA, Liberati A, Lohr K, McGowan J, Mulrow C, Norton M, Page M, Sampson M, Schünemann H, Simera I, Summerskill W, Tetzlaff J, Turner L, Tovey D & Whitlock F (2015) Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews* **4**.

Morrish NJ, Wang SL, Stevens LK, Fuller JH & Keen H (2001) Mortality and causes of death in the WHO multinational study of vascular disease in diabetes. *Diabetologia* **44**, S14-21.

Noar SM, Benac CN & Harris MS (2007) Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological Bulletin* **133**, 673-693.

Persell SD, Keating NL, Landrum MB, Landon BE, Ayanian JZ, Borbas C & Guadagnoli E (2004) Relationship of diabetes-specific knowledge to self-management activities, ambulatory preventive care, and metabolic outcomes. *Preventive medicine* **39**, 746-752.

Portney LG & Watkins MP (2009) *Foundations of Clinical Research: Applications to Practice*. Pearson/Prentice Hall.

Radhakrishnan K (2012) The efficacy of tailored interventions for self-management outcomes of type 2 diabetes, hypertension or heart disease: a systematic review. *Journal of Advanced Nursing* **68**, 496-510.

Mayo Clinic (2014) Risk factors for developing heart disease, July 2014. Mayo Clinic web page. Avalible at: http://www.mayoclinic.org/diseases-conditions/heart-disease/basics/risk-factors/con-20034056 (accessed 10 April 2016)

Riegel B, Moser DK, Anker SD, Appel LJ, Dunbar SB, Grady KL, Gurvitz MZ, Havranek EP, Lee CS, Lindenfeld J, Peterson PN, Pressler SJ, Schocken DD, Whellan DJ, on behalf of the American Heart Association Council on Cardiovascular Nursing CoCC, Council on Nutrition, Physical Activity,, Metabolism, Care ICoQo & Research O (2009) State of the Science: Promoting Self-Care in Persons With Heart Failure: A Scientific Statement From the American Heart Association. *Circulation* **120**, 1141-1163.

Saleh A, Hammoudeh AJ, Hamam I, Khader YS, Alhaddad I, Nammas A, Tarawneh H, Tabbalat R, Harassis A, Bakri M, Alnaquib A, Izraiq M & Al-Mousa E (2012) Prevalence and impact on prognosis of glucometabolic states in acute coronary syndrome in a middle eastern country: The GLucometabolic abnOrmalities in patients with acute coronaRY syndrome in Jordan (GLORY) study. *International Journal of Diabetes in Developing Countries* **32**, 37-43.

Schulz KF, Altman DG & Moher D (2010) CONSORT 2010 Statement: Updated Guidelines for Reporting Parallel Group Randomized Trials. *Annals of Internal Medicine* **152**, 726-732.

Sedgwick P (2014) Randomised controlled trials: balance in baseline characteristics. *BMJ* **349**, g5721.

Scottish Intercollegiate Guidelines Network (2012) Methodology Checklist 2: Controlled Trials, 2ed. Scottish Intercollegiate Guidelines Network, Edinburgh. Available at: http://www.sign.ac.uk/methodology/checklists.html (accessed 10 April 2016).

Soja AM, Zwisler AD, Frederiksen M, Melchior T, Hommel E, Torp-Pedersen C & Madsen M (2007) Use of intensified comprehensive cardiac rehabilitation to improve risk factor control in patients with type 2 diabetes mellitus or impaired glucose tolerance--the randomized DANish StUdy of impaired glucose metabolism in the settings of cardiac rehabilitation (DANSUK) study. *American Heart Journal* **153**, 621-628.

Stellefson ML, Hanik BW, Chaney BH & Chaney JD (2008) Challenges for Tailored Messaging in Health Education. *American Journal of Health Education* **39**, 303-311.

Toobert DJ, Hampson SE & Glasgow RE (2000) The Summary of Diabetes Self-Care Activities measure: results from 7 studies and a revised scale. *Diabetes care* **23**, 943-950.

Uchmanowicz I, Loboz-Grudzien K, Jankowska-Polanska B & Sokalski L (2013) Influence of diabetes on health-related quality of life results in patients with acute coronary syndrome treated with coronary angioplasty. *Acta Diabetologica* **50**, 217-225.

van Loveren C & Aartman IHA (2007) [The PICO (Patient-Intervention-Comparison-Outcome) question]. *Ned Tijdschr Tandheelkd* **114**, 172-178.

Ware JE, Kosinski M & Dewey JE (2001) *How to score version 2 of the SF-36 health survey: standars & acute forms*. QualityMetric. (2nd Edition). Lincoln, RI: QualityMetric, Inc

Wermeling PR, Gorter KJ, van Stel HF & Rutten GEHM (2012) Both cardiovascular and non-cardiovascular comorbidity are related to health status in well-controlled type 2 diabetes patients: a cross-sectional analysis. *Cardiovascular Diabetology* **11**, 121-121.

WHO (2015) Diabetes. World Health Organization-Media centre, WHO website. Available at: http://www.who.int/mediacentre/factsheets/fs312/en/ (accessed 21 March 2016).

Wu C, Chang AM, Courtney M & Ramis M (2012a): Using user-friendly telecommunications to improve cardiac and diabetes self-management programme: A pilot study. *Journal of evaluation in clinical practice* **18**, 695-697.

Wu CJ, Chang AM, Courtney M & Kostner K (2012b): Peer supporters for cardiac patients with diabetes: A randomized controlled trial. *International nursing review* **59**, 345-352.

Wu CJ, Chang AM & McDowell J (2009) Innovative self-management programme for diabetics following coronary care unit admission, pp. 396-399-396-399.

Yiling J C, Imperatore G, Geiss LS, Jing W, Saydah SH, Cowie CC & Gregg EW (2013): Secular Changes in the Age-Specific Prevalence of Diabetes Among U.S. Adults: 1988-2010. *Diabetes care* **36**, 2690-2696.